

are formed, the most prolific field of inquiry is promised by the study of the drop- and bubble-size as a means of proximate chemical diagnosis*. It does not appear that bubble-volume is at present likely to afford an additional equation for gas-analysis; but we have seen that both drop-size and bubble-size may offer very valuable criteria as to the constitution of liquids. And although the former (drop-size), especially in the case SL_1L_2 , is by far the most sensitive to variation in the chemical constitution and proportion of mixed constituents, the latter has the advantage of requiring a much less amount of liquid, and of being applicable to every liquid without regard to its solubility in other liquids.

II. "Note on the Invisible Radiation of the Electric Light." By
JOHN TYNDALL, F.R.S. Received January 13, 1865.

Pending the preparation of my complete memoir, which may occupy me for some time to come, I would ask permission of the Royal Society to lay before the Fellows a brief and partial summary of the results of my experiments on the invisible radiation of the electric light.

The distribution of heat in the spectrum of the electric light was examined by means of the linear thermo-electric pile, applied to the solar spectrum by Melloni, Franz, Müller, and others. The electric spectrum was formed by lenses and prisms of pure rock-salt, its width being equal to the length of the row of elements forming the pile. The latter, standing at right angles to the length of the spectrum, was caused to pass through its various colours in succession, and to search the spaces beyond the region of colour, in both directions.

As in the case of the solar spectrum, the heat was found to augment from the violet to the red, while the maximum heating effect was observed beyond the red, and at a distance from the red, in one direction, equal to that of the green of the spectrum in the other.

The augmentation of temperature beyond the red in the case of the electric light is sudden and enormous. Plotting from a datum line the thermal intensity of the various portions of the spectrum, the ordinates suddenly increase in length beyond the red, reach a maximum, and then fall somewhat more suddenly on the other side. When the ends of the ordinates are united, the curve beyond the red rises in a steep and massive peak, which quite dwarfs the luminous portion of the spectrum.

The comparative height and steepness of this peak are much greater than those obtained by Professor Müller for the solar spectrum. Aqueous vapour acts powerfully upon the invisible rays; and doubtless the action of this substance in our atmosphere has toned down the eminence beyond the red in Professor Müller's diagram. A solar spectrum, produced beyond

* Some word is required to denote the acquirement of the knowledge of the constitution of a substance without taking it to pieces (analysis). "Diagnosis," used in its purely etymological sense, answers this purpose.

the limits of the atmosphere, would probably exhibit as steep a peak as that of the electric light.

In the experiments now to be referred to, the rays from the electric light were converged by a small concave mirror. The glass mirror silvered at the back, which usually accompanies the camera of Duboscq's electric lamp, was one of the first employed. It was brought so near the electric light as to cast an image of the coal-points five or six inches in advance of the light. A solution of iodine in bisulphide of carbon, contained in a rock-salt cell, was then placed in front of the lamp: the light was thereby cut off; but the focus of dark rays remained, and various effects of combustion and incandescence were obtained at the focus. A mirror 4 inches in diameter, and silvered in front, will enable an experimenter to obtain most, if not all the results now to be mentioned. I also employ a mirror 8 inches in diameter, and having a focal length of 8 inches, with excellent effect.

It is not necessary to enclose the opaque solution in a rock-salt cell. The vessel intended for a solution of alum, which usually accompanies the lamp of Duboscq, and the sides of which are of glass, answers admirably. It is, however, not quite deep enough for the several tests to which I have subjected it, and in crucial experiments I employ a deeper vessel with rock-salt sides.

With the 8-inch mirror just referred to behind the electric light, the opaque solution in front, and the focus of invisible rays about 6 inches distant from the electric light, the following effects have been obtained:—

1. Wood, painted black, when brought into the dark focus, emits copious volumes of smoke, and is soon kindled at the two spots on which the images of the two coal-points fall.

2. A piece of brown paper placed near the focus soon shows a burning surface, which spreads over a considerable space, the paper finally bursting into flame.

3. Black paper brought into the focus is immediately inflamed.

4. The wood of a hat-box similarly placed is rapidly burnt through, and usually bursts into flame.

5. The end of a cigar, placed at the dark focus, is instantly ignited.

6. Disks of charred paper placed in the focus are raised to brilliant incandescence, surfaces of considerable extent being brought to a vivid glow. Charcoal is also ignited.

7. A piece of charcoal, suspended in a receiver of oxygen, is ignited in the dark focus and caused to burn brilliantly, the rays after crossing the glass of the receiver being still sufficiently powerful to heat the coal up to incandescence.

8. A mixture of oxygen and hydrogen is exploded in the dark focus by the ignition of its envelope.

9. A piece of zinc foil, blackened on one side to diminish reflexion, is pierced and inflamed. By gradually drawing the strip, once inflamed, across the focus, it may be kept blazing for a considerable length of time. This is a particularly beautiful experiment.

10. Magnesium wire, presented suitably to the focus, burns with its intensely luminous flame.

In all these cases the effect was due, in part, to chemical action; this, however, may be excluded.

11. A plate of any refractory metal, sufficiently thin, and with its reflective power suitably diminished, is raised to incandescence in the dark focus. Gold, silver, copper, aluminium, and platinum have been thus rendered incandescent.

12. Platinized platinum shows the effect best: in a thin leaf it may be rendered white-hot, and on it is depicted an incandescent image of the coal-points. When the points are drawn apart, or caused to approach each other, their incandescent images conform to their motion.

The assemblage of phenomena here described, and others to be referred to in my completed memoirs, may, I think, be properly expressed by the term *Calorescence*. This word involves no hypothesis, and it harmonizes well with the term fluorescence, now universally employed with reference to the more refrangible end of the spectrum*.

III. "Note on a New Object-glass for the Microscope, of higher magnifying power than any one hitherto made." By LIONEL S. BEALE, M.B., F.R.S., F.R.C.P., Professor of Physiology and of General and Morbid Anatomy in King's College, and Physician to King's College Hospital. Received December 30, 1865.

I desire to record the completion of a new objective, with a magnifying power double that of the twenty-fifth. This glass is a fiftieth, and magnifies nearly three thousand diameters with the low eyepiece. Messrs. Powell and Lealand, the makers, to whom science is indebted for this the highest power yet made, produced a sixteenth in the year 1840, and the twenty-sixth in 1860.

The fiftieth defines even better than the twenty-fifth, which is now made instead of the twenty-sixth. Plenty of light for illuminating the objects to be examined is obtained by the use of a condenser provided with a thin cap, having an opening not more than the $\frac{1}{30}$ th of an inch in diameter. The preparation may be covered with the thinnest glass made

* On the 5th of last December I tried the passage of the rays from the electric lamp through a great number of differently coloured glasses. Incandescence was obtained through almost all of them; and in one instance, the radiation passing through a blue glass, the thermograph of the coal-points was of a *pink colour*. A thick black glass, obtained from Mr. Ladd, when held in front of the lamp, was found to be not perfectly opaque; still the platinum could not be raised to incandescence a tall when placed in the focus. Being called away from the Royal Institution early in the afternoon, I gave directions to my assistant, Mr. Barrett, to continue the experiments. He informs me that on placing in the path of the rays a combination of two thin plates of black glass, one transmitting a whitish-green, and the other a deep red, the light was entirely intercepted, and feeble though distinct incandescence was obtained at the focus. With radiation through the solution of iodine, the thermograph on this day rose to a white heat.